welcome to the
European Microkelvin Collaboration

CAPACITIES

Application Form for MICROKELVIN Transnational Access Project

1. General Information

Project number:	**AALTO34**	
Project Title:	**Noise in quantum phase slip superconducting nanowires**	
Lead scientist:[1]	**Title:**	Dr.
	First name:	Konstantin
	Last name:	Arutyunov
	Home institution:	University of Jyväskylä
Host scientist:[2]	**Title:**	Prof.
	First name:	Pertti
	Last name:	Hakonen
	Home institution:	Aalto University
Project scientist:[3]	**Title:**	Dr.
	First name:	Konstantin
	Last name:	Arutyunov
	Scientific Field:	Mesoscipic superconductivity
	Home institution:	University of Jyväskylä
	Is your home institution MICROKELVIN partner?	No
	Business address:	University of Jyväskylä, Dept. of Physics, NanoCentre
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	Telephone:	+358408054061
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	E-mail:	konstantin.yu.arutyunov@jyu.fi
	Curriculum vitae (18 lines max): **Current scientific interests:** Interface and quantum size phenomena at nanoscales. Non-equilibrium superconductivity. Quantum nanoelectronics. Applied nanotechnology **Education and degrees**: • (2012) Doctor of Physical-Mathematical Sciences (= highest scientific degree in Russia) • (2002) Docent in Material physics (U. of Jyväskylä, Finland) • (1989) Ph.D. in Physics. (Moscow State University, Russia) • (1985) M.Sc. (Physics Faculty, Moscow State University,Russia) **Employment history**: • (2004-pr.) Adj. professor, Docent, NanoScience Centre, University of Jyväskylä (Finland), PI: 'Quantum nanoelectronics • (2002-2004) Assistant professor ("yliassistentti") and (1999-2002) Senior researcher, Department of Physics, University of Jyväskylä (Finland) • (1998) Research Fellow, Lab. Vaste-Stoffysica en Magnetism, Katholieke University Leuven (Belgium) • (1995-1998) Prime Assistant, Physics Faculty, Lausanne University (Switzerland) • (1989-1995) Junior Scientific Researcher / Scientific Researcher, Low-T Lab., Physics Faculty, Moscow State University (Russia) • (1985-1988) Ph.D. student, Low Temperature Dept., Physics Faculty, Moscow State University (Russia).	

[1] The lead scientist indicated here is expected to participate in the campaign as a user of the infrastructure.

[2] The host scientist is supervising the work of the visiting project scientist at the infrastructure.

[3] The project scientist is the person who will be visiting the infrastructure.

	Five most recent publications:
	1. O. V. Astafiev, L. B. Ioffe, S. Kafanov, Yu. A. Pashkin, K. Yu. Arutyunov, D. Shahar, O. Cohen, & J. S. Tsai. Coherent quantum phase slip, **Nature** 484, 355 (2012).
	2. K. Yu. Arutyunov, T. T. Hongisto, J. S. Lehtinen, L. I. Leino, and A. L. Vasiliev. Quantum phase slip phenomenon in ultra-narrow superconducting nanorings, **Sci. Rep**. 2, 293 (2012).
	3. J. S. Lehtinen, K. Zakharov, and K. Arutyunov, Coulomb blockade and Bloch oscillations in Superconducting Ti nanowires, **Phys. Rev. Lett**. 109, 187001 (2012).
	4. J. S. Lehtinen, T. Sajavaara, K. Yu. Arutyunov, M. Yu. Presnjakov and A. Vasiliev, "Evidence of quantum phase slip effect in titanium nanowires", **Phys. Rev. B** 85, 094508 (2012).
	5. J. S., Lehtinen and K. Yu., Arutyunov, The quantum phase slip phenomenon in superconducting nanowires with a low-Ohmic environment, (invited topical paper), **Supercond. Sci. and Technology** 25, 124007 (2012).

Other participating scientists:[4]	**Name:**	**Position:**	**New User:**
	1-Janne Lehtinen	PhD student, JYU	YES
	2-Taneli Rantala	MSc student, JYU	YES
	3-		

2. Project Information

Name of host infrastructure:	**LTL, Aalto University**			
Access provider / Infrastructure Director:	**Name: Hakonen**		**E-mail address: pertti.hakonen@aalto.fi**	
Planned project dates:	**Start date:**	**2/6/2013 18/8/2013**	**Completion date:**	**15/6/2013 31/8/2013**

Project description (12 lines max):

The project targets at an experimental study of noise spectra originating from the quantum fluctuations in nanoscale superconductors. The subject is of multidisciplinary nature requiring state-of-the-art nanofabrication, advanced material science, ultra-low-T and microwave techniques, as well as complex theoretical analysis. The majority of the measuring activities will be carried out at the host institution (LTL, Aalto University) providing the required experimental infrastructure, while the nanostructures will be fabricated at the visiting scientist's laboratory (NSC, Jyväskylä). Theoretical analysis is undertaken as an international collaboration. The project envisions ground-breaking discoveries in basic science and has strong potential to open new horizons in such fields as quantum metrology and nanoelectronics. The objectives correspond to the long-term vision of development of the subject of superconductivity, in general, and superconducting nanoelectronics, in particular. The results of the project will provide important contributions to our understanding of the nature of quantum solids, and the very foundations of quantum coherent phenomena.

Scientific objectives of the project (12 lines max):

The main objective is to study current noise spectra in superconducting nanostructures governed by quantum fluctuations (phase slips).

In case of 1D voltage-biased nanowires the objective is twofold. The first step is to obtain sufficient sensitivity to resolve the current noise. Ideally, it should be possible to distinguish between the strongly temperature dependent contribution of thermal phase slips (close to the critical temperature) and quantum behavior well below Tc. The second step is to perform measurements (of a similar system) embedded in a high-Ohmic environment to study the coherent QPSs in the limit of charge localization.

In a loop geometry, the objective is to study the noise of coherent QPSs representing the ground state of a macroscopically coherent quantum system.

[4] Please list all participating user group members. Expand the table, if necessary.

Technical description of work to be performed (20 lines max):

Shot noise contains information on the electronic transport properties that cannot be obtained by simple conductance measurements. Moreover, shot noise can be used to probe the electronic temperature of mesoscopic systems and it is even possible to use this effect as a primary thermometer. Given that a phase slip event is identical to tunneling, it is reasonable to assume that it should provide a certain contribution to the noise spectrum. To the best of our knowledge, a model describing current noise in QPS-governed nanowires has not been proposed so far. We are also not aware that someone has performed any systematic studies of the effect.

The Aalto team has expertise in measuring shot noise in various mesoscopic-size objects at ultra-low temperatures. The JYU team will fabricate the nanostructures: (i) 4-terminal nanostructure with an array of parallel superconducting nanowires in the regime of QPSs; and (ii) hybrid tunnel nanostructures comprising as a central electrode the superconducting loop in the regime of QPS. First, we will use our 'working horse' materials: Al and Ti. For them we know the range of diameters when the QPS effect develops. If some positive results come out, we will eventually try also other materials.

3. Joint Proposals / Funding

Is this project in collaboration with other (concurrent) projects at the infrastructure	**No**
If yes, please specify:	

Is this proposal submitted to any funding programmes?	**No**
If yes, please specify:	

The completed Application Form should be submitted to MICROKELVIN Management Office
(**Sari.Laitila@aalto.fi**, fax +358-9-47022969)